A VTOL AirVenture

Wisk flew its uncrewed, fifth-generation Cora at AirVenture. (All photos by the author.)

This year's AirVenture had more vertical flight content than ever before.

By Kenneth I. Swartz

The Experimental Aircraft Association's (EAA) 70th anniversary AirVenture fly-in and convention broke many records, including the number of helicopters and vertical takeoff and landing (VTOL) aircraft on public display. AirVenture 2023 was held July 24–30 in Oshkosh, Wisconsin.

Widely known simply as "Oshkosh," AirVenture is unlike any other airshow, fly-in or trade show in the world, as evidenced by the record 675,000 attendees, 848 commercial exhibitors and the 10,000 fly-in aircraft that converge on Oshkosh's Wittman Regional Airport and nearby airfields, supported by more than 5,000 volunteers.

There was a total of 3,365 show planes, including a record 1,497 registered in vintage aircraft parking, plus 1,067 homebuilt aircraft, 380 warbirds, 194 ultralights, 134 seaplanes and amphibians, 52 aerobatic aircraft and at least 41 rotorcraft.

EAA was founded in 1953 in Milwaukee, Wisconsin, with the initial goal to assist amateur-built aircraft builders, but it soon grew to encompass all aspects of sport aviation. The first fly-in convention was at Curtiss-Wright Airport (now Timmerman Field) in Milwaukee that first year, then moved to Rockford, Illinois, in 1959, and then to Oshkosh in 1970 when it outgrew Rockford.

For decades, Oshkosh has been where the manufacturers of ultralight and experimental-category helicopter and gyroplane kits came to demonstrate their newest aircraft models and sign up new customers.

Since 2017, electric VTOL (eVTOL) aircraft developers have joined the exhibitor ranks, led by EHang and Kitty Hawk, who were the first eVTOL companies to exhibit aircraft at AirVenture. Kitty Hawk made one of the world's first public flight demonstrations of a piloted eVTOL aircraft with a prototype Flyer at the EAA seaplane base on Lake Winnebago on July 28, 2017 (see "Back to Kitty Hawk," *Vertiflite*, Nov/Dec 2017).

Sensing the changing times, the Comparative Aircraft Flight Efficiency (CAFE) Foundation also moved its annual Electric Aircraft Symposium (EAS) from the San Francisco Bay Area to the University of Wisconsin Oshkosh in July 2017 and asked the author (on behalf of VFS) to participate for the first time.

The CAFE Foundation started as a mid-1970s outgrowth of EAA Chapter 124 in Santa Rosa, California, where members were interested in advancing the development of fuel-efficient general aviation aircraft. In 2007, CAFE held its first EAS in San Francisco. Many credit the Symposium with kickstarting Silicon Valley investment in eVTOL aircraft development,

which was then amplified at the first VFS Transformative Vertical Flight (TVF) Workshop in 2014 — today's annual Electric VTOL Symposium.

During the COVID-19 pandemic, VFS administered the virtual EAS in 2020 and 2021, and then took over as the organizer of EAS in 2022 (see "Electric Aircraft Symposium Highlights AAM Progress," pg. 44). Many of the visionaries and VTOL companies — whose first exposure to VFS was at EAS and AirVenture — have become individual and corporate VFS members actively engaged in the Society.

This year, vertical flight had a solid presence at EAA AirVenture with aerial performances by companies like Gravity Industries and Wisk in the airshow, and a surprising number of gyroplane, helicopter and eVTOL aircraft makers announcing new products, building on previous years (see "The EAA AirVenture VTOL Adventure," *Vertiflite*, Sept/Oct 2018, "Oshkosh e-AirVenture" *Vertiflite*, Sept/Oct 2019, and "Return to Oshkosh: EAA AirVenture 2022," *Vertiflite*, Sept/Oct 2022).

EAA CEO Jack Pelton said advanced air mobility (AAM) will become a bigger part of AirVenture as the industry develops, which means the vertical flight content will continue to grow, along with an emphasis on electric aviation.

Airshow Center

AirVenture is a fly-in, a trade show, an educational conference and a social event, with a daily afternoon airshow. Most of the 2023 airshow performers were piloting aerobatic, antique, warbird and military aircraft, but this year featured more VTOL aircraft than previous years.

Wisk flew its Cora eVTOL aircraft before hundreds of thousands of enthusiasts on two different days. Opportunities to see the Cora in flight have been extremely limited, except for those who've visited the company's primary flight test sites at Hollister Airport, California, or the Canterbury region of New Zealand, where Wisk has based an aircraft since late 2017.

At AirVenture, the uncrewed, two-seat aircraft took off from the southeast corner of the airfield, transitioned to show center and then flew to both ends of 8,000-ft (3.4-km) long Runway 18-36 before returning to the show center to land. The sound of the Cora's 12 independent, electrically driven lift propellers and single pusher propeller was undetectable over other airport sounds, which included the auxiliary power units (APU) of some large commercial jets and military transports in the static display area.

This was the first time Wisk exhibited at Oshkosh, and the company's large exhibit building was difficult for attendees to miss since it was next to parent-company Boeing's exhibit hall on the most heavily traveled section of the vast AirVenture exhibit grounds.

Inside, Wisk displayed the mockup of its sixth-generation electric air taxi with a team of well-primed employees ready to brief visitors on the aircraft design and business plans, which calls for the certification of a fully autonomous aircraft design without a pilot or any flight controls.

Gravity Industries inventor and CEO Richard Browning gave stunning demonstrations of his latest jet suit with five turbojet engines.

A flight demonstration by Gravity Industries immediately followed Cora, which saw inventor and company founder Richard Browning and a colleague in camouflage jet suits fly the same flight pattern as Wisk, but at a much lower altitude and much closer to the crowd.

Browning launched Gravity Industries in 2017, after he made his first jet suit flight the previous November, which was powered by six commercial off-the-shelf micro turbojet engines. He then released two videos on the *WIRED* magazine and Red Bull sites that attracted a huge amount of interest and some serious investors. Development began while Browning was working as an oil trader for petroleum giant BP; he had always been a tinkerer and his maternal grandfather was Sir Basil Blackwell, a former CEO of Westland Helicopters.

Gravity's flights at Oshkosh were astonishing from takeoff to landing for this first-time observer of any kind of jet suit flight. The company's design has been continuously refined over the past six years with business revenues coming from special event appearances and individuals booking a flight experience at the company's Goodwood facility near Chichester, UK.

Elsewhere on the AirVenture grounds, California-based Mayman Aerospace displayed its compact, high-speed VTOL P2 Speeder (N727XS, serial SP2-001) prototype in the AFWERX tent.

Australian serial entrepreneur David Mayman teamed up with design engineer Nelson Tyler in the US more than a decade ago to develop the JB9 JetPack. Mayman successfully flew it for the first time without a safety tether system in June 2015 near Sacramento, California, and then around the Statue of Liberty in November that year.

JetPack Aviation Corporation was established in 2016 and developed the JB10, JB11 and JB12 jetpacks, which had more thrust, more engines and better management systems to cope with an engine failure.

Mayman has stated that the Speeder concept was born in 2016 when the company was working with the US Navy SEALs; the Navy identified a requirement for a motorcycle-sized VTOL aircraft that could lift 300 lb (130 kg) and had greater range and speed than the jetpacks.

Rebranded as Mayman Aerospace, the company started conducting tethered testing of the Speeder in May 2021. Then in August 2021, the Speeder concept was selected by the US Air Force and US Special Operations Command to participate in its High-Speed VTOL Concept Challenge (see "Air Force Challenges Industry for High-Speed VTOL," *Vertiflite*, Sept/Oct 2021 and "JetPack Aviation Takes Off," *Vertiflite*, March/April 2022). In September last year, the Air Force announced that Mayman had received $1.25M in funding from its AFWERX Agility Prime program.

The Speeder on display had eight gimballed micro turbojets, a target empty weight of 200 lb (90 kg), a payload capacity of 600 lb (270 kg) and the ability to fly 175 nm (320 km) at 250 kt (480 km). Flight testing is progressing and Mayman expects to offer an uncrewed version to potential customers in about 18 months' time.

Other companies (and VFS members) hosted by AFWERX included eVTOL developers Joby Aviation and Beta Technologies, as well as hybrid-electric developer VerdeGo Aero. VerdeGo unveiled their new 185-kW VH-3-185 hybrid-electric propulsion system, based around an SMA Aero Engines four-cylinder, 230-hp (170-kW) SR305 diesel engine, which is made in Germany.

"One of the conflicts that's happened many times in this industry is the collision between what I will call aircraft physics and money physics," Eric Bartsch, CEO and co-founder of VerdeGo, told *Vertiflite*, explaining that money physics "has to do with what you can get funded."

VerdeGo Aero CEO Eric Bartsch highlighted the company's VH-3-185 hybrid-electric propulsion system.

"And so often in the early days of a technology revolution, the things that progress the most quickly are the things that the money is flowing to. Those aren't necessarily the things that the physics flows you to. And it's exciting because what we're seeing now is really the money physics and the real physics are starting to align with each other again, as it typically has happened in the past with other technology revolutions. And people are realizing we need to focus on the things that are going to work and the things that are gonna deliver a big impact.

"So, I would say over the last nine months, we've seen a dramatic change in how many airframers are talking either openly or behind closed doors about needing hybridization in their aircraft, because they're realizing that the benefits of their aircraft are really driven by electric motors and not batteries. And batteries are the thing that are holding them back the most… and that really favors things like the VH-3-185 or the larger powerplants in VerdeGo's portfolio."

The daily AirVenture flying program also included aerobatic performances by two different MBB Bo 105 light twin-engine helicopters operated by Pylon Aviation of Arizona and Red Bull, respectively, on different days.

Most of the daily four-hour airshow was dominated by fixed-wing aircraft, which included as many as 60 warbirds flying overhead in formation on some days. Friday, July 28, brought a nice change of pace when eight Sikorsky Black Hawks of the Wisconsin Army National Guard appeared on the horizon and staged an airborne assault on show center with soldiers with the 1st Battalion, 147th Aviation Regiment. Two medevac Black Hawks conducted live hoists, simulating a casualty evacuation, while a USAF F-35 Lightning II fighter jet and KC-135 tanker circled overhead.

The military content also included a static display of a US Air Force Special Operations Command Bell Boeing CV-22 Osprey, as well as an Army Airbus UH-72A Lakota, a Boeing MH-6 Little Bird, AH-64 Apache and CH-47 Chinook, and a Sikorsky UH-6M Black Hawk. A US Coast Guard HH-60T Jayhawk from Air Station Traverse City, Michigan, rounded out the display.

Other helicopters operated by missionary groups and aviation degree granting universities could be found throughout the AirVenture site. The University of North Dakota Aerospace School in Grand Forks displayed one of their five Robinson R44 Cadets used for pilot training, while the US Naval Test Pilots School in Patuxent River, Maryland, parked one of its white and orange Airbus UH-72A Lakotas beside a Navy recruitment tent.

Honoring Veterans

Every year AirVenture highlights a number of themes. This year, one theme was the aircraft of the Vietnam War.

As many as nine Black Hawks and a Jay Hawk participated at AirVenture, in addition to an Osprey and numerous additional US Army helicopters.

A former French Army Gazelle, now privately owned, was part of the warbird flight line.

Historically, helicopters have only accounted for a few of the 300+ warbird aircraft flown to Whitman Field by private owners. But this year, a record dozen helicopters arrived, including a Bell TH-13, a pair of Hughes TH-55s trainers, a Hughes OH-6A Cayuse, a Bell OH-58 Kiowa and a pair of Bell UH-1H Hueys.

There were three standout rotorcraft on the warbird flight line. One was a privately-owned ex-French Aviation Légère de l'Armée de Terre (ALAT) Aérospatiale (now Airbus) SA342 Gazelle. The Iowa Technology Institute brought a Mil Mi-2 Hoplite it uses in flight test research (see "Leadership Profile: Prof. Thomas Schnell, University of Iowa," *Vertiflite*, July/Aug 2017). And former US Marine Corps Sikorsky UH-34D Seahorse "YL-37" (N855BA, ex-148783) — which served with Marine Heavy Helicopter Squadron HMM-362 in Vietnam and was restored as a "flying memorial" by the YL-37 Group Foundation in Inola, Oklahoma, in the late 1990s — gave flying displays as well.

Busy Heliport

Thousands of people flew over the massive AirVenture grounds in a Robinson R44 and a fleet of four Bell 47G models — two 47G2s, a 47G-3B1 and a 47G5A. All the passenger rides

Thousands of people flew over the massive AirVenture grounds in one of four Bell 47Gs or a Robinson R44.

originated from Pioneer Airport, adjacent to the EAA Museum. The five-minute flights over the AirVenture grounds cost $65 per person and ran continuously for 10 hours a day for all seven days of AirVenture.

The westernmost portion of Pioneer Airport next to Highway 41 becomes a large public-use heliport during AirVenture. Before the COVID-19 pandemic, one would usually see a half-dozen helicopters parked on the grass each day while their pilots visited AirVenture. This year, there was a noticeable increase in fly-in visitors with 18 helicopters parked on one day, including numerous Robinson R44s sharing the field with Robinson R66s, MD500Ds, an Airbus H125, Enstrom 480B, MBB Bo 105 and an elegant Leonardo A109S Grand.

Meanwhile, at the east end of Pioneer Airport, airspace was set aside for radio-controlled (RC) model aircraft flights and drone delivery demos by Wing, a subsidiary of Alphabet, Inc. (parent company of Google) that also develops uncrewed aircraft system (UAS) traffic management (UTM) systems.

Sadly, AirVenture 2023 was marred by the loss of three aircraft and four fly-in participants. A two-seat T-6 Texan crashed into

Wing employees Lewis Cooper and Justin Gormly demonstrated the autonomous takeoff and landing capabilities of their delivery drone.

Lake Winnebago on the morning of July 29. Later that day, a RotorWay 162F helicopter and an ELA Aviation ELA 10 Eclipse gyrocopter collided while operating from the Ultralight Airfield located at the south end of the exhibition grounds; the two helicopter occupants were killed while the two people in the autogyro survived with injuries.

MOSAIC Rule

There was a lot of chatter at AirVenture about how the US Federal Aviation Administration's (FAA's) proposed Modernization of Special Airworthiness Certification (MOSAIC) rule unveiled on July 19 — the week before AirVenture — would expand the definition of Light Sport Aircraft (LSA) to include rotorcraft and electric propulsion for the first time (see "Washington Report," pg. 12).

While developers of larger eVTOL aircraft face new pilot training and certification challenges arising from the agency's proposed Special Federal Aviation Regulations (SFAR) on "Integration of Powered-Lift: Pilot Certification and Operations" (see "Industry Vets FAA's Powered-Lift SFAR," pg. 14), every ultralight and experimental category gyroplane, helicopter, eVTOL and LSA-class aircraft maker *Vertiflite* met at Oshkosh believed that MOSAIC would stimulate significant new product development activity and customer demand. The public has 90 days to comment on the proposed MOSAIC rule, which ends on Oct. 23, 2023.

World's First eVTOL Owner-Pilot

When Tim Lum started watching eVTOL videos during the COVID-19 pandemic, he had no idea he would become the world's first customer for a recreational eVTOL aircraft.

The retired US Air Force Reserve pararescue specialist, 26-year wildfire smokejumper and contract search and rescue helicopter flight paramedic has spent decades jumping out of aircraft and dangling on a hoist from helicopters to save lives and battle wildfires, often from the US Forest Service smokejumper base in Winthrop, Washington, near his home in the North Cascades mountains.

As a long-time paraglider and power paraglider enthusiast used to taking recreational flights from local mountain ridges since 1993, Lum saw an early Opener video online and the BlackFly really caught his interest. He first met representatives of Opener last year at a tradeshow in Las Vegas and said he'd like to buy an aircraft. In January 2023, Lum was invited to the Palo Alto headquarters and on arrival was greeted by the entire Opener staff; he was surprised to learn the company had selected him to be the first BlackFly Early Access Program (EAP) customer and he got to sit in the cockpit of a BlackFly for the first time.

In March, Lum returned to Palo Alto to commence flight training and "must have done a hundred simulator flights" over three days before he made his first BlackFly flights.

Tim Lum, with an Opener BlackFly, is essentially the world's first eVTOL owner-pilot.

Lum said he was surprised by the tremendous acceleration on takeoff, "because you literally pivot back… your back's to the ground [and] your feet are up like an Apollo astronaut. That's what it looks like," he said with a laugh. "And then you give a throttle command to go up and it's a lot of power you don't expect."

Lum's first flight lasted 90 seconds and included a climb to 30 ft (9 m) and then forward flight with a series of turns followed by a slow descent. He recalled, "It was amazing."

He then called a "time out" and insisted on staying on the ground to watch another Opener "operator" fly the BlackFly, because "I'd never seen the aircraft in flight before!"

In mid-June, a team from Opener arrived at Lum's home with his BlackFly (marked TL39) in a custom trailer. A clearing next to his home on a 2,700-ft (822-m) high ridge in the North Cascades has since become the launch point for almost daily flights up to 10 miles (16 km) away. Lum charges the BlackFly with his household solar panels and can trailer the aircraft to locations further afield behind his Tesla.

Opener recently released a spectacular video of Lum's early flights that was shot from drones near his mountaintop home.

"Flight in a BlackFly is amazing. Even though I've been in and around aircraft for years, this is my first time as an official VTOL pilot," said Lum in a press release.

"And the connection with my BlackFly goes well beyond the aircraft itself. It's all the things that Opener does to assist me — from extensive flight training to delivery and ongoing support. The level of hands-on service is off the charts." For example, performance data from every one of Lum's BlackFly flights is automatically transmitted back to Opener.

Opener flew piloted BlackFly aircraft at AirVenture in 2021 and 2022. The company expects to announce additional EAP customers as it gears up for full-scale production.

Rotor X Unveils Dragon eVTOL

Since buying the assets of RotorWay International in 2021, entrepreneur Don Shaw has relaunched it as Rotor X Aircraft Manufacturing Company at its original facility in Chandler, Arizona. The company resumed kit helicopter and spare parts production, introduced the new Phoenix A600 Turbo model with a 180-hp turbocharged engine and launched development of a family of new VTOL aircraft.

At AirVenture, Rotor X unveiled a preproduction version of its single-seat Dragon eVTOL personal air vehicle (PAV) with eight propellers. It has an endurance of about 20 minutes for pilots weighing up to 250 lb (113 kg) and has swappable battery packs that recharge in less than two hours. Designed to meet the FAA's Part 103 ultralight rules, the aircraft has a maximum weight of 254 lb (115 kg) and is equipped with a roll cage, energy absorbing landing gear and a ballistic parachute.

Since the Dragon was announced last year, Shaw says, "we've had a big response and we've actually been taking orders. The first customers will be able to come to our facility and we'll train them how to build it," with customer assembly of a Dragon expected to take a week.

Now Shaw says, "there has been enough interest in a two-seat version that we hope to develop this fall."

Like the single-seat model, the four arms holding the motors and propellers on the two-seat Dragon will fold to reduce the footprint for transport and storage. But it will require larger motors, propellers and more batteries, placing it in the LSA weight category, where the certification rules are about to change as a result of the MOSAIC initiative.

Another rotorcraft in development with sister company Advanced Tactics is a four-rotor, 8,000-lb (3.6-metric-ton), large-cabin helicopter called the Heavy Lift Transport (HLT). It uses the same 25-ft (7.6-m) diameter rotor and engine as the Phoenix A600 Turbo. Shaw expects the prototype to make its first flight by late 2023 and be demonstrated in early 2024 to the US Air Force, which has provided most of the HLT project funding.

Rotor X resumed manufacturing operations with a small crew of only 12 that has grown to 35 employees. Shaw is now looking for a second factory site in the Chandler area to support future Dragon production.

Rotor X CEO Don Shaw sits in the new Dragon single-seat ultralight eVTOL. The arms fold inward for transport and storage.

Over its life, RotorWay delivered more than 2,500 helicopter kits since it was founded in 1961.

Pipistrel

This year, Ivo Boscarol, the pilot, flight instructor and test pilot who founded the Pipistrel Group in Slovenia — a pioneer in the design and production of electric aircraft — received the EAA's August Raspert Award, presented annually to a person who has made an outstanding contribution to the advancement of light aircraft design.

In 2022, Boscarol sold the majority share of the Pipistrel Group of companies to Textron, forming its eAviation division. Under Textron's ownership, a Pipistrel Velis Electro electric-powered aircraft was donated to the EAA to be auctioned during a fundraiser and flown during the airshow.

Pipistrel Chief Technology Officer Dr. Tine Tomažič says the company's years of work on electric propulsion have given it a portfolio of core technologies and building blocks that it can apply to mobility solutions serving the cargo and air taxi markets.

"As an example, Pipistrel's, large cargo drone project, the Nuuva utilizes eight electric engines that are now employed on Velis Electro. There's also carryovers in the battery technology [applied to the] Nuuva, as well as to Textron eAviation's Nexus project. So, once you start building up your technology portfolio, it's almost intrinsic that with electric propulsion and different architectures, you will be able to cover a much broader segment of flight."

Tomažič said that the cargo volume capacity of the tandem wing Nuuva V300 "about matches the volume in a Cessna Caravan. So, it's not a small plane. It holds three full cargo palettes."

The Nuuva V300 will have a maximum payload of about 660 lb (300 kg) and a range of about 300 nm (550 km), cruising at a speed of 115 kt (213 km/h) with a hybrid-electric propulsion system. The lift propellers will be battery powered and the

pusher propeller powered by an internal combustion engine that uses automotive fuel, since "we want the Nuuva to operate where chargers don't exist. We don't want to have an infrastructure dependency baked into the product," he said.

"The availability of deploying electric propulsion technology unlocks different ways of how we can move cargo, priority cargo [and] perhaps medical supplies [that need to] move quickly or overnight to locations [without] infrastructure, with mountainous terrain, islands and other kinds of locations. The Nuuva V300 is not trying to replace a certain airborne cargo application or an aircraft solution. It's trying to open up the segment to flying where cargo is already going, but not served by air. And it [will] be very helpful [to respond to] climatic events or conflicts that we are witnessing in the last year or two."

Pipistrel is now assembling the first Nuuva V300 in Slovenia and it will be "very nice to see the vehicle in flight quite soon," added Tomažič.

He believes that the FAA's draft of the MOSAIC Rule "is an exciting prospect to bring more innovation into the lower end of general aviation." This includes the introduction of the Velis Electro as the first electric-powered training aircraft in the US — under current FAA rules, LSA-category aircraft must be powered by an internal combustion engine and all rotorcraft were excluded.

Beta Technologies

For the second year, Beta Technologies exhibited alongside AFWERX, but this year the company brought a large trailer housing a flight simulator.

Chris Caputo, who oversees flight operations and training at Beta and regularly test flies the Alia 250, told *Vertiflite* that the company now has two full-scale, piloted, proof-of-concept aircraft flying. Aircraft N250UT is the company's electric conventional takeoff and landing (eCTOL) aircraft, which had made 372 piloted flights as of Oshkosh. N251UT is the company's eVTOL aircraft, which had made 88 flights.

"On our eVTOL variant, we've gone from the furthest forward edge of the center of gravity envelope, lightest weight, heaviest weight, all the way to the very aft edge of the envelope. We've cleared the entire aircraft weight-wise and all the aircraft handling characteristics. We've got a great platform from which to base a lot of our production vehicle."

Initial hover testing of the eVTOL N251UT took place in mid-2022 at Burlington International Airport in Vermont, then the aircraft flew as a conventional aircraft across Lake Champaign to Plattsburgh International Airport, New York, where its eVTOL testing resumed. It has also made conventional takeoff and landing flights to Burlington and back as recently as August 8–9.

The eCTOL N251UT is the only prototype with a market survey certificate right now that permits cross-country flights. The company is looking forward to the first deployment of the aircraft to Duke Field, which is part of the Eglin Air Force Base complex in Florida.

Beta is the midst of transitioning from a research and development business to a production and manufacturing business. Beta is expecting a certificate of occupancy of its new 188,000 ft² (17,500 m²) manufacturing plant at the end of August.

Vertical Aviation Technologies

Vertical Aviation Technologies returned to AirVenture after a multi-year absence, displaying its Hummingbird 300L helicopter — with the latest six-cylinder 300-hp, fuel-injected Lycoming Thunderbolt IO-540, derated to 245 hp (183 kW) — outside the Lycoming Engines' stand.

The Hummingbird displayed by VAT (N300VC) won the helicopter Grand Champion award at AirVenture 2023. It was built by Vic Syracuse of Locust Grove, Georgia, who is a passionate fixed-wing and helicopter commercial pilot, EAA technical advisor and monthly columnist in *EAA Sport Aviation* magazine.

Syracuse documented every step in his Hummingbird's construction in a six-part "Building the Beater" article in *Kitplanes* magazine. He's been involved in aviation for over 40 years, built 11 award-winning aircraft and logged over 10,000 hours in 72 different kinds of aircraft.

During the 33-year life of the four-seat Hummingbird, VAT has developed more than a half-dozen engine installations for its kit-helicopter, which is based on the 1949 Sikorsky S-52-2, powered by the long-out-of-production, 245-hp, six-cylinder Franklin engine. The Thunderbolt series of engines, including the IO-540, are Lycoming's brand of high-performance, built-to-order powerplants for Experimental Category aircraft.

Sikorsky delivered 93 S-52s during the aircraft's limited production run, but VAT has sold more than 300 Hummingbird kits around the world, starting with a large inventory of

Vertical Aviation Technologies displayed its Hummingbird 300L.

surplus S-52 parts and then gradually making all-new parts and components and improving upon the design.

"The original objective of selling a kit was to meet the FAA's 51% owner-built assembly requirement for experimental aircraft. This kept the price of the helicopter cost low and stimulated more sales of its four-seat rotorcraft," VAT CEO Bradley Clark said at AirVenture.

Today, "our key message is that we're selling a real engineered, certified design, and we're selling it as a kit where the customer puts it together — which makes it affordable." A typical kit requires about 1,200 hours to complete, plus work on the interior and avionics.

In 2017, Clark began pursuing a Primary Category type certificate for the Hummingbird, "so I could put the aircraft together for a customer." VAT spent three years modeling the whole helicopter in SolidWorks to support the production line plans.

Then VAT bought the S-52 type certificate from Sikorsky, which will allow it to incorporate the modifications and improvements it's made to the S-52 design and sell the Hummingbird 300L for commercial use — something a kit helicopter and primary category rotorcraft can't do.

Composite-FX

Last year, Composite-FX test flew an electric-powered version of its single-seat XE-Series helicopter (commonly known as the Mosquito) in Trenton, Florida, on July 21, 2022 — the last day before the company had to truck it to Oshkosh for public display.

The original Mosquito kit was introduced as an ultralight kit helicopter more than 20 years ago. It was later upgraded with different piston and turbine engines and an enclosed cockpit, in the Experimental Category.

This year, the company returned to Oshkosh with six different helicopter airframes, including a new variation of the XE-Volt Mosquito electric helicopter propulsion system.

"Last year, our electric motor was coupled one-to-one with our tail rotor, and then it went through our conventional drive line to the main rotor," explained Composite-FX Operations Director Norbert Richter. "The system worked fine, but the motor controller required a constant 200 amps. In the second iteration, the installation now has a reduction unit, and the motor is running at a higher RPM, which means it dissipates less heat."

Richter sees the development work as a path to a hybrid helicopter that will carry less weight in batteries and more in payload. The interest is primarily coming from Composite-FX's drone customers — about 50 of the more than 450 helicopter kits produced to date were used as drones.

The batteries on the XE-Volt are installed in a pair of cutout water tanks mounted on both sides of the helicopter cabin below the rotor mast. The water tanks were originally installed

Composite-FX brought six variants of its single-seat kit helicopters, including this autonomous, uncrewed Mosquito.

by Rain Industries, which developed an uncrewed firefighting version of the Mosquito known as the Rain MK2.

"The idea of a hybrid is to get greater longevity out of the machine. Right now, our 12-gallon [45-l] fuel tank on this machine is empty. And in a hybrid configuration, if we can make those 12 gallons of fuel last longer for our customers, then we have greater range, among other things."

Richter also noted that the company could effectively have four or five new helicopter models quite quickly that could be type certified under the new MOSAIC rules. "So, we're very excited because that opens up the chance to do production line work instead of the 51% rule."

Ordering a kit helicopter requires a series of large out-of-pocket expenses that can't be conventionally financed, adds Richter. "The MOSAIC proposals may open the door for conventional finance for these machines, potentially opening up this helicopter to a different customer."

A photo album of VFS images from the author is available on the VFS Photo Gallery at ***https://gallery.vtol.org/albums****. Videos of the Wisk Cora flight and interviews of many of the exhibitors can be found at* ***https://youtube.com/VTOLSociety/playlists****.*

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